1.6 Application: Representing Colour

The physics behind how we perceive colour is incredibly interesting, but also complex. Humans have developed a broad range of names of colours to identify categories like "red" in everyday language.[1] Yet these categories can be fairly broad and imprecise; useful for everyday communication, but not for computer graphics and design. So in this section, we'll learn about how computers represent colour data.

Mathematics can help us represent colours by a combination of numbers; the rules for how numbers map to colours is called a *colour model*. Many colour models exist, but one of the most common is the *RGB colour model*. At some point in your youth, you may have discovered that mixing two colours together (i.e., with paint, crayons, etc.) produces a different colour. The RGB colour model is based on the same idea: each colour is represented by three numbers, one for the "amount" of red, green, and blue to be mixed together.

A common form of the RGB colour model in a computer is called the **RGB24** colour model, and allows for each of the red, green, and blue amounts to be a number between 0 and 255, inclusive.[2] Formally, we can define the set $S = \{0, 1, \ldots, 255\}$ and $\mathcal{C}$ to be the set of all

[1] Although the names we use for colours vary widely from language to language!

possible colours in the universe. Then the RGB colour model is a function $RGB_{24} : S \times S \times S \to \mathcal{C}$ that takes in red, green, and blue values from S and returns a colour. This RGB_{24} function is *one-to-one*, as every combination of (red, green, blue) values produces a different colour.

RGB Value	**Colour**
(0, 0, 0)	
(255, 0, 0)	
(0, 255, 0)	
(0, 0, 255)	
(181, 57, 173)	
(255, 255, 255)	

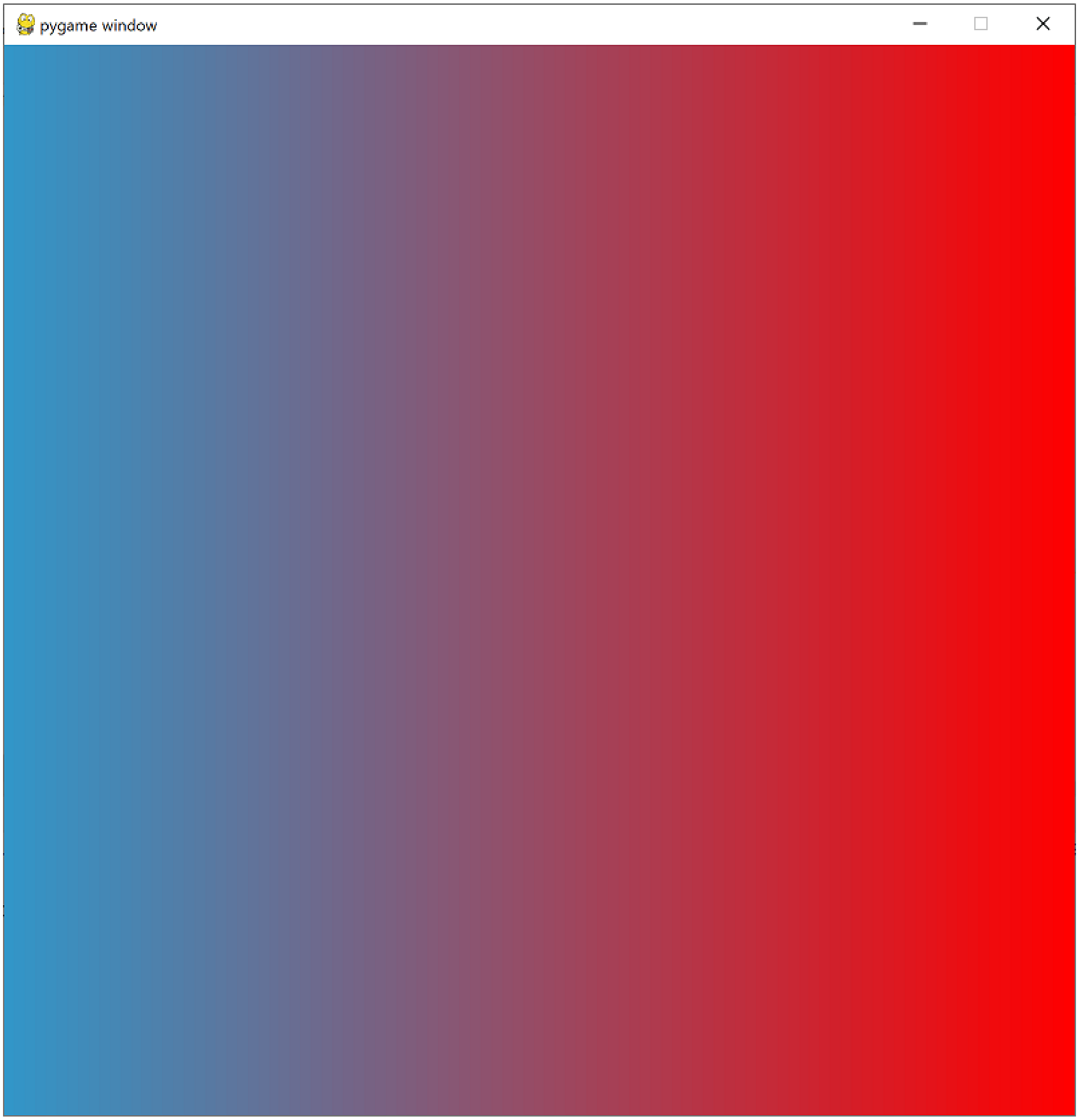
Colours in Python

The RGB24 colour model translates naturally to Python: we represent a colour value as a tuple of three integers, where each integer is between 0 and 255, inclusive. For example, we can use `(0, 0, 0)` to represent a pure black, and `(181, 57, 173)` to represent a shade of purple. Of course, just representing these values as tuples doesn't automatically make them colours:

```
>>> (181, 57, 173)  # This tuple evaluates to... itself
(181, 57, 173)
```

But as you'll see in your first tutorial this year, we can pass these tuples to operations that expect colour values, and get remarkable results.

[2] Though RGB24 is quite common, software like Photoshop allow for a larger range of numbers, enabling more granularity it their colour representations. You can look up the term *deep colour* to find out more about more sophisticated colour models



References

- Hexadecimal Colors
- Color Theory

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